

# A Spitzer Study of Pseudobulges in S0 Galaxies: Secular Evolution of Disks

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**Abstract.** A comparison of pseudobulges in S0 and spiral galaxies is presented using structural parameters derived from 2-d decomposition of mid-infrared images taken at  $3.6 \mu\text{m}$  by Spitzer IRAC. The position of the bulges on the Kormendy diagram has been used as an initial classification criterion for determining the nature of the bulge. To make the classification more secure, the criterion proposed by Fisher and Drory (2008) has also been used, which involves using the  $n = 2$  division line on Sérsic index. We find that among the 185 S0 galaxies, 27 are pseudobulge hosts while 160 are classical. Of these 25 pseudobulge hosts, only two belong to the bright luminosity class ( $M_K < 22.66$ , AB system) while rest belong to the faint luminosity class ( $M_K > 22.66$ , AB system). We find that among spiral galaxies, 77 % (24 of 31) of the bulges are classified as pseudobulges. As pointed out by various studies, the presence of such a large fraction poses problems to our current picture of galaxy formation. However, our primary result is that the disk scale length of pseudobulge hosting S0s is significantly smaller on average than that of their spiral counterparts. This can be explained as a lowered disk luminosity which in turn implies that S0s have evolved from spiral progenitors. We also argue that early type spirals are more likely to be the progenitors based on bulge and total luminosity arguments. We speculate that if late type spirals hosting pseudobulges have to evolve into S0s, an additional mechanism along with gas stripping of spirals is needed. We have also investigated the effect of environment on pseudobulges in the two samples, but no significant trends were found in the properties of the pseudobulges as a function of the various structural parameters. The study is made more difficult because of the low number statistics one deals with when the sample is sub-divided based on whether it is in a field or group/cluster environment. The study of pseudobulges based on environment, however, is an interesting one and is something that can be considered for the future by carefully selecting a sample with statistically meaningful number of objects from diverse environments.

**Keywords.** galaxies: spiral and lenticular - fundamental parameters galaxies: photometry - structure - bulges galaxies: formation - evolution

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